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Editorial

Scientific Education in India. It is only a balanced scientific education that can help to creat "a well informed public and enlightened citizen, that are the best security of a democratic State." The introduction of free and compulsory education for boys and girls from the age of six to fourteen made the western democracy practically sound and safe. In the words of the National Planning Commission we have to convert the mass of mere literates into a body of independent, intelligent workers and responsible citizen of a free democracy. We have to mobilise the entire man power of the country to fit into an over all national plan to work intelligently each in his or her own appropriate role, so that they become real architects of their own as well as their country's prosperity. The scope of the scientific education in India has been ably visualised in the report of the University Commission, constituted by a group of eminent American, British and Indian educationists and presided over by Dr. S. Radhakrishnan, the great educationist of international reputation. Dissemination of learning, incessant search for new knowledge, increasing effort to plumb the meaning of life, provision for professional education to satisfy the occupational needs of our society are the vital tasks of scientific education.

The solution of our industrial and other problems depends essentially on our scientific bias in education in India. National Laboratories and Research Institutes will play an ever increasing part in furthering the application of Science to industry. Universites which are really the fountain heads of knowledge must, therefore, supply a " constant flow of scientific workers and leaders imbued with zeal and zest for research." This is the opinion of Dr. Bhatnagar, who has also pleaded for much larger research grants to universities and other research organisations. The head of the State can help to suggest, as indicated by our contemporary Science and Culture Vol. 18. No. 1. 1952, that

(a) A directive that the States should spare at least 20% of their budget on education with a special bias for scientific education.

(b) That the Centre should spend 10% of its budget on education and

(c) That the sums allotted in the Central Government's budget should be spent through properly constituted agencies.

The Social responsibilities of Scientists trained through these institutions should, thus, help to promote 'Scientific integrity' in India which will be her great contribution to world thought and world peace.

The father of the nation thought, however, that there had been a fundamental error in the educational policy of our country through alien rule and to ameliorate its evil effects conceived of the basic education plan. Many advanced thinkers do believe that its craft-centred emphasis is indeed a form of appropriate scientific education for India.

In the new scheme of scientific education for India, the Agricultural College and Research Institute, Coimbatore offers great opportunities for the progress of scientific education and fundamental research, designed to canalise the energies of the workers and peasants coming to this institution.

In conclusion it may be mentioned that the co-operation of the public with the Government is quite essential for the successful working of a system of scientific education in any country. In this connection the marvellous examples set by other countries like the United Kingdom and United States of America are worth following in India. Particularly in transforming the results of scientific research in rural areas, difficulties to be encountered are not only many but also of varied complexities. For a successful solution in this direction the co-operation of the public with the State will be of immense value. Financially also the public can rely to a very great extent the various Scientific Institutions and make them function usefully and efficiently. The latest developments in India are fairly encouraging and it is fervently hoped that the needs of the nation will soon be solved completely and successfully by men of good scientific education.

Methods to be adopted to Maximise Production and Development of Improved Strains of Millet Seeds *

By
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Millet Strains of the Madras State: Millets are small grained cereals which are grown in the drier tracts of this State. There are eight of them, Viz., Cholam, Cumbu, Ragi, Tenai, Varagu, Samai, Panivaragu and Kudiraivali. The total areas occupied by these crops is about 13 million acres, the annual production being about 3 million tons of grain. As a result of the work carried on at the five Millet Stations and seven district Stations, 77 strains have so far been released for distribution. The trials conducted with strains have demonstrated their superiority over the local types and their capacity to yield on the average 10 to 15% more grain than the cultivators' seed. The general demand for improved seeds has been steadily mounting, and if adequate supplies are made available, much larger areas would be cropped with the improved seeds of Millets.

Present Organisation for Production and Distribution of Improved Seeds: It was to remedy this defect of short supply and to produce adequate quantities of improved seeds, and distribute them to the cultivators that a separate organisation under the name of "Seed Development Scheme" was created in 1949. Under this Scheme the organisation and running of primary seed farms and the procurement of seeds are carried on under the dual control of the Seed Development Officers and the District Agricultural Officers. The organisation of secondary seed farm is completely under the District Agricultural Officers and is carried on by the Agricultural Demonstrators in charge of the taluks. The area covered by the improved strains, both through district distribution and natural spread, after the Seed Development Scheme came into existence, is estimated to be about 16 lakhs of acres. Compared with the figures available till the end of 1948, there is an increase of about six lakhs of acres in this area during the course of three years.

Methods suggested to maximise production and development of improved strains of Millets: On a rough estimate, it may be said that the strains already evolved so far are suitable for about 40% of the total area under Millets i. e. about five million acres. Adopting an average seed rate of 10 lb. per acre, about 23,000 tons of improved seeds are required to sow an area of five million acres. Compared with this enormous figure, the

* Paper contributed for College Day and Conference, 1952.

actual areas of seed farms sown and the quantities of seeds produced are very insignificant and hence there is urgent need to organise this aspect of extension work and devise efficient methods for maximising the production and development of improved strains. The following suggestions are submitted for consideration.

The question may be asked where is the need for State Organisation? Why is it not easy for each farmer to be self-reliant and maintain his seed pure? Our Country is one of millions of small farmers. Most of them do not bother about pure seeds. It is common experience that many farmers, mostly tenant farmers, go to the bazaar or shandy and purchase seeds from the village bania, just at the time of sowing and also paying an exhorbitant price for the same. The stuff they will be buying is not surely pure improved seed. The three million tons of millet grains produced in the State are mostly from seed of this kind. For each tenant farmer to keep improved seed separately for his use next year is a bother. He does not have the sustaining power to keep back sufficient seed for sowing for a period of six to eight months. This is the weakest link in the chain of production and it is here that the State should step in with its helping hand. Even in Western Countries where the holdings are very large, many farmers do not bother about the seeds. It is a problem for them to keep seeds pure and free from insects, for a long time. So every year many prefer to purchase marked seed from the certified seeds-men. The production and sale of improved seeds is a thriving business in Agriculture in the United States of America. Until our Country comes up to this level of private enterprise, it is the duty of the State to supply pure seeds to small farmers who are the back bone of our Country's Agriculture.

Intensification of seed development work by reducing jurisdiction: The division of work between Seed Development Officers made at present seems to be too broad to be effectively catered to. There are only two Seed Development Officers, one at Bellary and the other at Coimbatore, to organise and supervise the work in the State. Similarly the subordinate staff also are in charge of areas too wide for effective work. For obtaining the maximum benefit from the Seed Development Schemes, the work should be divided into smaller zones according to the importance of the crop, and other considerations.

Since the multiplication and distribution of improved seeds is as important as the evolution of strains through selection and hybridisation, if real benefit is to be derived from the latter, it is essential that the organisation for the development of seeds should be on a permanent basis just as the breeding work. It must also be remembered that the task of spreading the strain does not cease, once the seed is issued to the cultivators in a village. Improved seeds give increased yields so long as they remain pure, and the best results are obtained by keeping the seeds pure.

Appointment of Officers familiar with the breeding work on the crop: As the purity of seeds is the most important consideration in the spread of strain seeds, it is necessary that responsible officers on the Scheme should be persons who are intimately acquainted with the breeding work on the particular crops. Seed farm work is important as long as seeds are pure. If the question of purity is not given its proper place there is no need to spend money on seed farms.

Trial plot work: One of the important stages in the production of improved strains is to choose the best selection as the strain for a particular tract. This is done by what is known as trial plot work. This is carried out in cultivators' lands. The Breeding Station produces improved selections by plant breeding methods. The best three or four are picked out for trial in the Cultivators' fields in the districts. Trial or observation plots are laid out by the Demonstration Staff in the Cultivators' fields in a number of places in the district, compared with the local variety side by side. The best selection from these tests after sufficient confirmation, becomes a strain. This is the first step before seed multiplication of strain starts. The trial plot work is a very important stage in which both the Research Worker and the Demonstrator are equally interested.

Organisation of Seed farms in State owned or leased lands: Supply of improved seeds is one of the most popular work of the Department and is also a most useful result of agricultural Research. The seed supply is popular and the demand for seeds increases year by year. These demands have to be met from primary and secondary seed farms which have therefore, to be arranged on a large scale. Seeds of strains required for sowing primary seed farms are now supplied from the Breeding Stations. Land and irrigation facilities available at the Stations are very limited and it is with great difficulty and by curtailing breeding work to some extent that the supply of nucleus seeds is maintained. If the work of multiplication, storage and distribution of improved seeds is shifted to separate State managed seed farms under the charge of trained men, who will run them under the supervision of the Specialist or the Deputy Directors, it will yield better results. Suitable lands with facilities for irrigation can be acquired or taken on lease near the Breeding Stations and these seed farms can be run with the minimum staff so as to make itself sufficient, if not remunerative. These seed farms will demonstrate to the cultivators that it is worth while growing improved seeds as a commercial proposition for distribution.

Provision of facilities for purchase and storage of Seeds: In the "two year plan of Intensive Cultivation" sanctioned by Government, targets were fixed for areas of seed farms, quantity of seed to be purchased and area to be covered in each year of 1949–'50 and 1950–'51. According

to this Scheme, the quantity of improved seeds of Millet Strains to be purchased was estimated at 68,500 tons or about 8,20,000 bags. Even if this is distributed over 20 taluk depots, each will have to stock 40,000 bags of seeds and the space required for the periodical drying, cleaning and storage of these 40,000 bags is something very large, and the responsibility of keeping so much seed free from insects is too heavy to be shouldered by the Agricultural Demonstrator and his depot Clerk. That was perhaps one of the reasons why the purchase of seed was far below expectation, and the expected target was not often reached. This clearly shows that unless there are facilities for purchase and storage without damage and consequent financial loss to the holder of the stock, this Scheme cannot work satisfactorily. It is better that Seed Development Officers are provided with funds and godowns for purchase of seed from primary seed farms. The procurement of seeds from secondary seed farms may continue to be under the charge of the Agricultural Demonstrators under the guidence of the District Agricultural Officers. The Agricultural Demonstrators must also be provided with sufficient facilities for drying and storage of the seeds. Among the Millets, Cholam is the most easily damaged grain. But experiments conducted at the Millet Breeding Station have shown that if the seeds are dried well initially and then given periodical drying once in one or two months, even Cholam seed can be kept free from insect damage and without impairing viability for 10 to 20 months. Grains intended for seed purpose only can very effectively be protected against insect pests with the help of insecticides also after proper drying.

Provision of financial help to seed farm ryots: Another measure that will substantially help the development and production of improved seeds on a large scale, is the provision of sufficient financial help in the form of advances and loans free of interest. That will induce the cultivators to take up seed multiplication on a large scale. As the seeds have to be dried thoroughly and cleaned well, a higher price than what is fetched by ordinary grain in the open market is justifiable. The sale price of seed can be fixed at the level of price of grain in the open market and the difference of 10% can be subsidised by the State to popularise the work.

SUMMARY: The need for Seed Development Work in the State is explained. Suggestions for making the organisation more efficient, such as (1) reduction of jurisdiction, (2) permanent retention of staff, (3) appointment of officers familiar with breeding work on the crop, (4) intensification of trial plot work, (5) organising State-owned seed farms, (6) provision of proper facilities for purchases and storage of seeds over long periods and (7) provision of sufficient help to seed farm ryots and regulation of sale price, have been made.

Maximisation of Crop Production in the Ceded Districts *

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Introduction: The Ceded Districts of Anantapur, Bellary, Cuddapah and Kurnool constitute 20·8% of the total land area of the Madras State, which is about 80·7 million acres. Out of this a net area of 7·6 million acres is under the plough. The area under irrigation is small compared with the total area available for cultivation as indicated below :—

Anantapur – 11·0%
Bellary – 3·0%
Cuddapah – 26·5%
Kurnool – 6·0%

Want of assured and dependable irrigational facilities necessitates the ryots in this tract, (perhaps with the slight exception of those in Cuddapah) to depend mostly on rains for the cultivation of crops. Virtually, agriculture in this tract is a gamble with the monsoons. The situation is made worse by the frequent failures of the monsoons. The State has also realised the need for giving protection of a lasting nature to the ryots of this zone, to insure them and their cattle against famine conditions. Agriculturally, this zone forms a major millet producing area of the State and any attempt to improve the food production in the State envisages the exploration of all possibilities for improving the agricultural situation as a whole in the Ceded districts. The authors have, therefore, taken up a preliminary study of analysing the available crop and rainfall data in every one of the four districts constituting this zone. The five major cultivated crops have been taken into consideration for a correct perception of the relation between rainfall and crop yield and this study will be extended later on to other cultivated crops as well.

Materials and Method: All the available data from the season and Crop Reports (1901—1950), published by the Economic Adviser to the Government of Madras, were culled with reference to the major cultivated crops in this zone, namely, Cholam, Korra, Cambu, Cotton, and Groundnut. Data were collected on district – war basis. In addition, to gain an idea of the year to year performance of the crop in relation to the nature of precipitation in that year, the Administration and Station Reports of the Madras Agricultural Department were studied in detail.

* Paper contributed for College Day & Conference 1952.

In the light of the available literature on "Dry Farming" and the experience gained by the authors in Crop Weather research, suitable methods as indicated below, were adopted to analyse the data and formulate certain suggestions for the maximisation of crop production in this zone. The basic principle governing the method of analysis of data is in accordance with the agricultural practices in the tract.

The two main seasons are Mungari (Early) and Hingari (Late). Of the two, "Hingari" is the main crop season. The sowing season is surprisingly long and sowing of major crops starts early in June and ends in December, that is throughout the monsoonic periods. But the bulk sowing is done in the months of July, August, September and October depending on the development and performance of the monsoons.

Analysis of the data: (i) The 81 years rainfall data of these four Districts have been statistically analysed to study the relationship of the rainfall in spans of five inches with the performance of crops.

(ii) The total monsoonic showers received and the average acre yields of everyone of the five major cultivated crops were examined in detail.

(iii) The particulars given in the Season and Crop Reports for the year 1949—'50 on "General Agricultural Operations' in Ceded Districts were useful to study graphically the wide span of the sowing season for the different crops and the nature of general precipitation in the tract.

Discussion and Results: (i) In most of the years annual precipitation falls under a range of 16″ to 31″, and the mean of this range may be taken as the normal annual rainfall in the tract.

(ii) Study of the data on the influence of the total rains of the south-west monsoon and north-east monsoon, on the crop yields of the five important cultivated crops leads to the following tentative inferences:—

(a) *Cotton:* So far as cotton is concerned, it is not the total quantity of the rains received during the life period of the crop but the nature of precipitation and the time of receipt of rains that influence the yield. This finding is equally applicable to all the four districts of the zone.

(b) *Groundnut:* In the district of Anantapur and Bellary the total rainfall received has good influence on the yield of the groundnut crop, with a few exceptions. In the other two districts, the effect of total rainfall on the yield obtained is less significant, possibly due to the existence of the K. C. canal system providing protective irrigation. The crop would have received irrigations in times of need and consequently the adverse effect of insufficiency of rains is mitigated to a great extent.

(c) *Cholam:* For the cholam crop the rainfall received during the growing season has significant influence on the yield. The distribution is also important for normal yield as for any other crop.

(d) *Cumbu:* The rains in the growing period of this crop appear to have a decisive influence on its yield.

(e) *Korra:* Both for a pure crop and as a mixture with cotton the total rains received seem to have far less effect on yield than the nature of distribution of the precipitation itself.

(iii) The graph summarising the particulars of the 1949—'50 Report on the trend of sowing season in the tract, reveals that the vigorous sowing season covers a period of five months commencing from July onwards besides indicating the miserable plight of the farmers of this tract in having to take a mere chance, so to say, to decide the optimum period for such sowings.

Recommendations: To improve the agricultural status of the tract for bettering the food position in the State, intensive research has to be done on the following lines:—

(i) *Effectiveness and Intensity of Rainfall:* In these four districts there should be at least twenty effective rainfall gauges installed and an equal number of self-recording rain gauges to collect data on the nature of distribution of rains affecting the cropping programme of the tract. Simultaneous collection of soil moisture data in the twenty localities fixed for the installation of the above mentioned instruments will also throw light on the nature of variation of soil moisture content and its relation to the external air temperature and wind velocity for adoption of ameliorative agronomic practices in dry farming schemes.

(ii) Facilities are to be provided to assess, *in situ*, the intrinsic drought resisting capacities of the different strains of millets, cotton and groundnut released by the Madras Agricultural Department to enable the concerned plant breeders to evolve by judicious crossing the most drought resisting strains of the major cultivated crops, because the transpirational loss in plants is known to vary according to their inherent genetic capacity to economically utilise the available moisture besides their dependence on the adaptive factor of the locality.

SUMMARY: (1) The success or otherwise of crop production in Ceded districts depends on the nature of distribution of the precipitation. Cotton and groundnut bear typical testimony to this statement.

(ii) It is obvious that for producing a fixed quantity of plant material a definite amount of minimum water is essential. The peculiar dry farming practices existing in the Ceded districts' zone, lacking

dependable irrigation, require regional research to elucidate the scope for evolving a suitable dry farming technique for each group of land in the zone.

(iii) To satisfactorily improve the crop-outturn in this zone there seems to be no alternative except that of giving serious consideration to the recommendations made above.

Acknowledgement: The grateful thanks of the authors are due to Sri M. V. B. Narasinga Rao, Paddy Specialist, for his valuable help and guidance in the preparation of this paper. Their thanks are also due to all those responsible for the collection and compilation of the data published in the 'Season and Crop Reports'.

ERRATA

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Page	Line	For	Read
106	13	1·395 acres	1·403 acres
106	14	1930—31	1935—36
105	18	10·2	9·6

Page 106 from bottom 4th line to page 107 8th line delete.

Page	Col.	Line	For	Read
105	4	2	3,050,272	2,651,672
105	5	2	1·395	1·604
106	4	2	3,996,074	3,512,074
106	5	2	1·518	1·638

Studies on the Problem of Loss of Viability of Rice Seeds in Storage*

By

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I. Introduction: Oryza sativa, the species to which most of the cultivated rices belong, has great diversity of forms in India, varying with the seasonal and climatic conditions. Nevertheless, it is usual to find a particular variety adapting itself to different conditions of soil and climate. On this capacity of varietal adaptation, depends the success of "Introduction" as a method of crop improvement. In addition to the climatic factors that might facilitate the growth and development of an introduced variety, there are others that contribute directly or indirectly to its sustained popularity. Resistance to pests and diseases, consistency in response to intensive methods of cultivation, among others, have also to be taken into account in judging of a variety as suited to permanent cultivation in a locality. Still, the conditions may not be quite favourable to every phase of the life cycle from seed to seed of the variety introduced. A particular season or seasonal conditions might favour its growth and development to maturity but subsequent weather conditions and methods of storage might affect its rest phase as seed.

Strain CO. 3 isolated in Coimbatore and introduced into Malabar and South Kanara affords an interesting example. In these places CO. 3 is grown in August—September and harvested in December—January. In South Kanara the harvested grains are stored in straw-twist bundles called *Murra*, till the time of next sowing in August—September. The stored seeds thus pass through the wet weather period of South-West monsoon (June—July) which is marked by heavy rainfall and high humidity. At the time of sowing, the seeds stored in *Murra* are found to have lost viability to the extent of more than 50%, the percentage of germination going down to zero in some seasons. The same extent of deterioration is noted under conditions obtaining in Malabar also, if the seeds are stored in non-air-tight receptacles.

II. Literature: Srinivasan (1933) observed that *Garikasannavari*, the outstanding spring rice cultivated from February to May in the *Godavari* delta, lost viability if stored in basket bins and straw-twist bundles called *Mudicatta*. In order to avoid this the ryots sow the seeds as an intermediate crop from June to October (Autumn) as soon as it is harvested in May. It is a problem that affects the entire *Dalua* area of 200,000 acres in the delta. Parija (1940) observed this phenomenon in Orissa in the case of the *Dalua* or *Boro* (Spring) rices that are raised from

*Ramasastrulu Munagala Prize, 1952 — awarded for this paper.

January to April and occupying an area of nearly 30,000 acres. Here again, to avoid the storage problem the cultivators are forced to grow small seed plots in the main season for the *Dalua* crop immediately following.

The problem exists only in the case of winter and spring rices and it is presumed that the deterioration sets in as the stored seeds pass through a rainy period which brings about marked changes in atmospheric conditions. In South Kanara the introduced variety CO. 3 yields twice as much as the local variety it has partly replaced namely *Athikraya*, a red riced variety. It is preferred also for the reason that its kernel gives beaten rice of high quality and rice of good quality for the table.

This paper is an account of the studies undertaken on the various aspects of deterioration and the mode of inheritance of the character.

Literature on the storage of rice with reference to viability is meagre. All the studies related to its keeping quality in prolonged bulk storage and those of viability were only incidental. Srinivasan (1933) adopted nine methods of storage with the variety *Garikasannavari* and found that metallic receptacles alone maintained viability. Ramiah (1937) recorded that under conditions obtaining in Coimbatore where the stored seeds did not pass through a rainy spell, a great deal of variation existed among different varieties as regards viability in prolonged storage. He made the general observation that "it is the variety that germinates very quickly after harvest without a resting period, that loses its viability sooner". Saran (1945) adopted different methods of storage and noted viability after 27 months. He observed that seeds containing 10 to 12 percent moisture lost viability, the same seeds maintained viability when the moisture was brought down by desiccating agents or by drying.

III. Experimental: 1. On the differential maturity of the seeds: As the presence of immature and ill-developed seeds might bring about loss of viability the first set of experiments were undertaken to find out the extent of deterioration in such case. Winter strains PTB. 3, PTB. 4, PTB. 6 *(Athikraya)*, CO. 3, CO. 5, CO. 7, and GEB. 24, were harvested after 20, 25, 30, 35 and 60 days of flowering and stored in kerosene tins after the usual drying. Germination tests were conducted every month from June to October. (For the tests, samples were drawn from the receptacles and soaked for 24 hours in water before transferring to the germination trays. Tests were done in duplicate or replicates of four each and the figures given represent the average.)

From the results presented in Table I it will be seen that seeds of 20 and 25 days' maturity gave low percentages in all cases, both deteriorating and non-deteriorating types. This would show that

deterioration due to immaturity is of a nature different from that noticed in the case of mature seeds stored under aerobic storage in gunny or *Murra*.

2. Maturity and methods of storage: In another series PTB. 6 (Athikraya) and CO. 3, the local and introduced variety respectively, were harvested after 20, 25, 30 and 35 days of flowering. Each lot was stored in single gunny, double gunny, kerosene tin and *Murra*. The results are presented in Table II.

Here, within experimental limits, the degree of maturity had little effect on the loss of germinability. Single gunny, double gunny and *Murra* gave low percentage in the case of CO. 3, while PTB. 6 maintained satisfactory germination.

3. Place effect and methods of storage: In this experiment, varieties CO. 2, CO. 3, GEB. 24 and *Athikraya* grown in three different taluks of South Kanara were stored in tin and *Murra*. In *Murra* they were stored in two series one of which was kept on kitchen loft for smoking as practised by some of the ryots. Germinations were recorded from May to October.

Marked deterioration was noted in the case of *Murra*, a fall in germination by about 30% in July and more than 50% in August. Smoking improved germination to a very limited extent only. Seeds preserved in tin maintained viability throughout. CO. 2 and in certain cases GEB. 24 also deteriorated like CO. 3 while the viability of *Athikraya* was unimpaired. Variations in germinability were noticed between CO. 3 grown in different places. This would suggest that environmental factors acting on the crop had some influence on the extent of deterioration of the seeds.

4. (a) Aerobic and anaerobic methods of storage; CO. 3 harvested in South Kanara was stored under different methods listed below:—

1. Single gunny.
2. Double gunny.
3. Zinc bin.
4. Gunny lined inside with oil cloth.
5. Gunny lined inside with thick brown paper.
6. Kerosene tin.
7. *Murra*.

Percentages of germination given in Table I show that metallic receptacles preserved the seeds till October. Gunny lined with oil cloth gave 75% germination which would prove that the nearer the receptacles approached anaerobic condition, lesser was the loss of viability.

TABLE I.

Aerobic and anaerobic methods of storage.

Treatments :—

1. Single gunny.
2. Double gunny.
3. Zinc bin.
4. Gunny lined with oil cloth.
5. Gunny lined with thick brown paper.
6. Kerosene tin.
7. *Murra.*

Treatments	Percentage germination in				
	June	July	August	September	October
1.	98	78	36	27	3
2.	97	77	39	13	5
3.	93	96	98	98	100
4.	99	100	86	75	75
5.	98	82	36	13	8
6.	98	96	95	93	96
7.	99	68	21	15	12

(b) As confirmatory trials the following further methods of storage were adopted, the aim being to find out cheaper receptacles than metallic, for preserving the seeds. The descriptions of receptacles are given below :—

1. Kerosene tin.
2. Mud pot.
3. Mud pot made more impermeable by treatment over hearth.
4. Aska sugar gunny.
5. Wooden box.
6. Cement bin.
7. Metallic bin.
8. Murra.

Weekly germination tests were conducted from June to October. The results are presented in table II.

TABLE II.

Aerobic and anaerobic methods of storage.

Treatments :—

1. Kerosene tin.
2. Mud pot.
3. Mud pot made more impermeable by treatment over hearth.
4. Aska sugar gunny.
5. Wooden box.
6. Cement bin.
7. Metallic bin.
8. *Murra.*

Treatments	Percentage germination in I, II, III, and IV weeks																			
	June				July				August				September				October			
	*I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1	*	97	99	100	99	100	100	100	100	100	100	100	100	99	99	99	100	100	99	100
2		98	99	100	98	99	97	94	95	89	92	80	82	67	48	47	37	33	19	23
3		98	100	98	97	96	96	98	97	95	84	74	66	60	46	41	39	26	20	23
4		97	98	99	99	91	90	98	79	60	65	53	55	52	30	16	11	15	15	10
5		98	99	100	99	99	97	99	100	95	90	75	71	58	26	18	15	3	3	3
6		98	100	100	99	100	99	100	99	99	100	99	100	99	100	99	100	99	98	98
7		99	99	99	97	100	99	100	100	97	99	100	99	98	98	99	100	99	100	93
8		96	98	99	99	97	96	95	93	71	75	44	42	39	24	18	18	16	7	7

* Tests commenced only from II week of June.

Metallic and cement bins alone preserved the seeds. Deterioration set in in August in the case of aerobic storage in Aska sugar gunny and *Murra.* It was considerably less in the case of mud pot (treated) and wooden box.

(c) Another experiment was therefore conducted in which wooden box and mud pot were given one and two coatings of tar and from the results (Table III) it is seen that with one are two coatings of tar, wooden box maintained viability of seeds till the second fortnight of October.

TABLE III.

Modified methods of storage.

Treatments :—

1. Kerosene tin.
2. Cement bin.
3. Wooden box with one coating of tar.
4. Wooden box with two coatings of tar.
5. Mud bin.
6. Mud bin with one coating of tar.
7. *Murra.*

Treatments	Precentage germination in I and III weeks									
	June		July		August		September		October	
	I	III	I	III	I	III	I	III	I	III
1	100	100	100	98	97	100	99	99	99	100
2	99	99	99	97	98	99	99	99	100	99
3	99	98	97	98	97	98	97	97	96	96
4	100	98	98	98	99	99	100	100	98	99
5	98	100	99	97	95	94	84	81	27	22
6	98	98	98	97	95	93	84	87	36	21
7	100	99	98	93	87	70	47	39	27	13

(d) With the encouraging results obtained above, an attempt was made to stimulate anaerobic conditions making *Murra* impermiable to air. After packing, it was coated with a thick coating (about one inch) of cowdung and red earth. Germination tested in October gave 85% in the case of *Murra* plastered with cowdung and red earth.

TABLE IV.

Storage in *Murra*—modified.

Treatments :—

1. Kerosene tin.
2. *Murra*.
3. *Murra* coated with cow dung.
4. *Murra* coated with cow dung and red earth.

Treatments	Percentage germination in October
1	99·5
2	12·8
3	77·5
4	85·0

5. Germination of paddy (rice in husk) and rice: In order to find out if inability of the embryo to break the husk was the cause of low germinability, the tests were extended to rice as well after husking. The germination of Co. 3 stored in tin and *Murra* was compared to that of two non-deteriorating types PTB. 19 (*Athikraya*) and PTB. 21. From the results given in table V it will be seen that husking did not improve germinability.

TABLE V.

Comparative germination of rice and rice in husk.

Treatments	Percentage germination in October	
	Rice in husk	Rice
PTB. 19	98·5	91·0
PTB. 21	98·0	95·0
CO_3 in Tin	95·0	92·5
CO_3 in *Murra*	18·0	12·0

6. Treatment of seeds with fungicides; In another trial Co. 3 seeds were treated with naphthalene and fungicide Agrosan. GN at the usual rates and stored in *Murra*. Result of germination test (Table VI) showed that they had no effect in checking loss of viability.

TABLE VI.

Treatment of seeds and germinability.

Treatments :—

1. CO_3 treated with Agrosan—G. N. and stored in *Murra*.
2. CO_3 .. Naphthalens .. ..
3. CO_3 without any treatment .. ..

Treatments	July III week	August III week	September III week
1	93·8	19·3	5·3
2	90 5	27·0	7·8
3	87·0	13·8	5·8

7. Correlation of loss of viability with post harvest germinability : As a result of his experiments with rice varieties in prolonged storage, Ramiah (1937) had showed that a close relationship existed between loss of viability and lack of dormancy of the grains. Studies were under taken to see if the association would hold good in this type of deterioration of Co. 3 in aerobic storge. Fourteen varieties including Co. 3 were selected for study. Germination was noted on a random sample drawn immediately after harvest and the balance of seeds in each of them were stored in *Murra* (10 to 15 lb. each). Germination was tested in the last week of August. The results are presented in table VII. The value of *r* is found to be as high as + 0·7968 showing that the loss of viability is positively correlated to post harvest germinability.

TABLE VII.

Correlation studies on loss of viability and dormancy of seeds.

Varieties	Percentage germination immediately after harvest	Percentage germination after storage *Murra*
PTB. 3	..	94
PTB. 21	3	82
Karuva Kuttadan	26	60
Muthuchemba	2	91
Chempan	12	79
Chitteni	..	89
Kodiyan	69	52
Vellakoli	96	33
Kasipichodi	11	45
Muthu Samba	17	62
PTB. 15	31	66
PTB. 6	4	99
PTB. 16	46	54
CO_3	92	49

Coefficient of correlation r = +0·7968

Significant at 1% level.

8. Inheritance studies : With a view to find out the mode of inheritance of the character of deterioration and the possibility of evolving a non-deteriorating type of Co. 3, artificial crossing was attempted between a positively deteriorating and non-deteriorating type namely, Co. 3 and PTD. 19 (Athikraya) (*Vide* table V). Half the quantity of the seeds obtained in the F1 was stored in thin cloth bags alongside the parents and and germination was tested in October. It may be noted here that the same extent of deterioration was observed when samples of Co. 3 were stored in cloth bags. The description of the parents and F1 and the percentages of germination are given in table VIII.

TABLE VIII.

Description of parents and F. 1.

	CO. 3	F1.	PTB. 19.
(a) Colour of lemma and palea	Straw		Brown
(b) Rice	White		Red
(c) Size of grain	Fine		Medium Coarse
(d) Germination after storage	18·4%	(a) Straw (b) Red (darker) (c) Intermediate	96·5%
	34·0%	(d) 84·5%	99·0%

The F1 hybrid gave 85% germination showing dominance (though not complete dominance), of the non-deteriorating character. The straw colour of the lemma and palea and red pericarp were also dominant. F2 generation comprised 732 progenies. They were studied for type of grain, colour of lemma and palea, colour of pericarp and viability. They could be grouped into the following main groups.

1. Co. 3 type of grain, white rice, straw lemma and palea.
2. ... ... red ... ...
3. ... ... white ... brown ...
4. ... ... red ... ...
5. PTD. 19 type ... white ... straw ...
6. ... ... red ... .
7. ... ... white ... brown ...
8. ... ... red ... ...

One sixth of progenies in each group were stored in cloth bags for determining loss of viabitity and another one-sixth were carried over to F3 generation. The range of variation in germinability in F2 and F3 generations are presented in table IX.

TABLE IX.

Distribution of F2 and F3 generation.

	Percentage generation—F2.										
CO. 3	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	PTB. 19
16·1%	4	6	9	9	15	16	16	24	28	10	88·8
						F3					
14·0%	9	10	9	11	16	21	15	19	14	4	75·1%

As will be seen from the table the variation is continuous and the character may therefore be taken to be governed by multiple factors. The red colour of the pericarp itself is found to be of different intensities in different progenies with different ranges of germination showing the presence of many modifying minor genes. The average germination and range of variations in each group are presented in table X.

TABLE X.

Average and range of germination.

Type	Germination	Straw W. rice	Straw R. rice	Brown W. rice	Brown R. rice
CO 3 type	Average %	22·7	55·4	30·0	68·9
	Range	1·0—51·1	22·0—89·4	20·0—53 0	44·2—92·9
PTB. 19	Average %	47·1	71 2	55·0	84·3
	Range	15·0—83·0	23·0—96·4	22·0—87·9	59·0—94 8

The association of the non-deteriorating character in inheritance with the different morphological characters was determined by the Chi-square (x^2) test. From the results presented in table XI it will be found that the non-deteriorating character is highly associated with red pericarp and feebly with shape of grain and colour of lemma and palea.

TABLE XI.

Chi-square tests.

Germination	Colour of rice			Colour of lemma and palea			Shape of grain		
	Red	White	Total	Straw	Brown	Total	PTB. 19 type	CO. 3 type	Total
1—20	..	7	7	6	1	7	3	4	7
21—40	4	5	9	8	1	9	4	5	9
41—60	17	10	27	23	3	26	15	12	27
61—80	36	5	41	30	11	41	17	24	41
81—100	37	3	40	24	17	41	26	14	40
Total	94	30	124	91	33	124	65	59	124
Proportion:	0·75807	0·24194		0·73387	0·26613		0·52419	0·47580	
x^2	38·66			9·28			5·10		
Value of x^2 for P 0·01=13·277									

IV. Discussion: The experiments on different methods of storage as outlined in the foregoing pages were spread over a period of six years. In all seasons the loss of viability was found to set in after the month of July. One of the contributing causes for the deterioration might be the high atmospheric humidity prevailing during the months of June and July. Decrease in viability due to moisture in atmosphere was recorded in respect of wheat, oats and barley by Robertson *et al* (1939). Wide variations were noticed in the loss of germinability itself with reference to weather changes within the same place and with difference in place of cultivation. For instance, when germinability was reduced to less than 10% in the case of Co. 3 grown in Puthur and Mangalore that obtained from Moodabidri gave 50% germination in the same season. A range of one percent to 13% germination was noticed in the same place and for the same type of storage.

Immaturity of seeds might contribute to loss of viability in storage in all varieties but this type of deterioration was found to be different from that noticed in the case of Co. 3. Nevertheless, a fraction of the loss might be atributed to the presence of not-fully mature seeds as will be obtained if late developing tillers are caught in a spell of drought which is not uncommon during the ripening phase of winter rices on the West Coast.

The results clearly indicate that for storing varieties like Co. 3, the the containers have to be kept fairly air-tight if the seeds are to maintain cent percent viability; the nearer they approach aerobic condition, the greater is the loss of viability. Bearing this in mind, cultivators could devise measures to protect seeds against atmospheric humidity affecting the seeds in strong mud bins or wooden receptacles painted with two coatings of tar or the *Murra* itself plastered over with a thick coating of a mixture of cowdung and red earth would be more economical than metallic or cement bins and meet the situation to considerable extent. That the seeds absorb moisture under conditions of aerobic storage is certain. They become soft and do not crack under pressure. In such circumstances development of fungi is possible which might affect the embryo. However, dressing of seeds by fungicides like Agrosan. GN was not beneficial. Oxley (1948) working on wheat has suggested the possibility of a sub-epidermal mycelium as a cause of increased respiration of damp wheat and its deterioration. Whether such fungal growth is developed in rice seeds remains to be investigated.

The results set out in table VII would show that the loss of viability in aerobic storage between seasonal intervals is a varietal character. This is found to have a close correlation with the capacity of the grains to germinate immediately after harvest without a rest period. Ramiah's observation on rice in prolonged storage applies well in this type of deterioration also in which case, one of the solutions for the problem would be to induce dormancy by artificial means.

In the cross between CO.3 and PTB. 19 the F1 showed incomplete dominance while F2 generation showed wide range of variations, larger number of progenies ranging towards the non-deteriorating class than the other. The inheritance is essentially one of multi-factorial type modified minor genes. The character is associated with red pericarp and to some extent with colour of lemma and palea. One progeny of the CO.3 type and which is a double recessive for other characters, is in the F6 generation and is promising.

In tables VIII and IX are given the germination of parents in successive seasons of trial. The variations in both F2 and F3 generations show shifts towards either parents. In the season when F2 generation was grown the parents gave 16·1% and 88·8% but the progenies showed shifts on either side from 1% to 96%. Presumably this shift is

brought about by minor gene combinations. Since the parents also in certain seasons showed a range of 1·1% to 100%, the genetic shift in the F2 generation can be taken as an index of the potentiality of the parent types themselves. In this case for example, the effect brought about by minor genes in segregating progenies is of the same strength as that brought about by environmental factors on the parents.

V. Summary: 1. Loss of germinability was noticed when a variety like CO. 3 was stored during seasonal interval in receptacles which are not air-tight especially in straw-twist bundles called *Murra*.

2. Experiments conducted with different varieties and with different maturity showed that the deterioration was not due to immaturity of grains. Metallic and cement bins preserved the seeds.

3. Improvement in germination was noticed in the case of wooden box and mud bin when they were given one or two coatings of tar and in *Murra* when it was plastered over with a thick coating of a mixture of cowdung and red earth.

4. Experiments so far conducted did not indicate presence of superficial fungal infestation as a cause of deterioration since seeds treated with Agrosan. G. N. also lost viability.

5. The deteriorating character was found to be correlated with the capacity of the seeds to germinate after harvest without a rest period.

6. The inheritance of the character was found to be of the multifactorial type with continuous variations in the F2 generation. It was found to be strongly associated with red pericarp and to some extent with colour of lemma and palea.

VI. Acknowledgment:

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Methods to be Adopted to Maximise Rice Production and the Development of Improved Strains of Paddy *

By

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The use of improved strains is one of the easiest and cheapest methods of maximising yields as by this method alone it is possible to get 15 to 20% increased yield. From crop cutting experiments it is seen that the productive capacity of the improved strains increases to 33% in combination with manures. In view of the greater response of the improved strains to manures it should be possible to wipe out a great portion of the deficit by a campaign of intensive manuring in areas of assured water supply where the departmental strains are grown. There are now available strains of paddy evolved by the state suitable for the different tracts and for different seasons.

In the maximisation of yields in paddy great emphasis should be placed on the use oi green manures since paddy crop has been found to respond very well to green manuring. There are various green manures like sunnhemp, daincha, sesbania speciosa, pillipesera, wild indigo etc. Sesbania speciosa in addition to giving heavy tonnage is hardy and capable of withstanding either drought or water logging. The normal area under green manure arop in the State is about $1\frac{1}{4}$ millions acres—about $\frac{1}{8}$ of the area under paddy. For an adequate application of green manure the area under green manures should at least be trebled. As this may not be possible it is necessary to grow shrubs like Adothoda and Calotropis and green manure yielding trees like Gliricidia maculata, Pongamia glabra, Cassia siamea etc. in all waste places. An average paddy crop in an acre removes from the soil 48 lb. of Nitrogen, 23 lb. of phosphoric acid and 41 lb. of potash. To maintain soil fertility it is necessary that that atleast the qnantum of manurial ingredients removed from the soil should be returned to it. It is well known that the paddy crop responds well to nitrogenous manures. Oil cakes and ammonium sulphate are the nitrogenous manures in vogue. The application of groundnut cake at the time of planting at $2\frac{1}{2}$ to 3 bags and ammonium sulphate at 100 lb. per acre about a month before flowering will meet the nitrogen requirement of an average crop. The quantity of groundnut cake and ammonium sulphate required to manure 8·5 million acres of wet paddy is many times more than the quantity available. As it is not possible to produce more groundnut cake or increase the production of ammonium sulphate or import large quantities, other sources of

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nitrogenous manures should be explored. The composting of farm waste and town refuse has not been done in this country as much as in Japan and China. All farm waste and town refuse and night soil should be composted and used as manure. Town refuse compost has been found to be as good as farm yard manure and the bulky applications, besides providing the required nitrogen, add to the organic matter content of the soil. The adoption of the T. V. A. plan of indirect manuring has been found to give better yields than the direct application of phosphates to paddy crop. Fertilising the leguminous green manure crop preceding paddy at 45 lb. P_2O_5 will be profitable method of applying phosphates as the application of phosphates stimulates the nitrogen fixing bacteria to greater activity. The soils of this State are sufficiently rich in potash and the response to potash has not been appreciable.

By improved cultivation alone it is possible to increase yields upto 30%. Timely sowing and planting of the crop is a primary requisite for maximum yields. Most of the samba varieties are season bound and unless the sowing and planting are done at the appropriate season there is appreciable reduction in yield. To enable the cultivator to raise the nursery in time and prepare the plot for planting, all irrigation sources like tanks and wells should be improved and kept in perfect repair. If need be, wells should be deepened or dug and other sources of irrigation like tube wells should be made available. In the raising of seed beds it is essential that the seed rate adopted is optimum. One Madras Measure of seed sown in one cent of seed bed is the correct seed rate for a samba crop. For a short duration crop the seed rate may go upto 3½ lb. per cent. It has been found that spacing and number of seedlings per hole has significant bearing on yields. Though the number of seedlings per hole and the spacing vary with conditions, two seedlings planted 6″ x 6″ for a samba crop and two seedlings planted 4″ x 4″ for a short duration crop have been found to be most remunerative. The quantity of water required to manure a crop of paddy varies with the type of soil. It is the common practice to maintain about 2″ of standing water throughout the growth period of the crop. Experiments have shown that one inch of water let in once in three days gives equally good result.

Freedom from pests and diseases is one of the requirements for maximum yields. The loss from insects pests both in the field and in storage is estimated to be 10% to 15%. The chief pests of paddy–the army worm and the rice bug–are controlled by DDT and BHC insecticides. Zinc phosphide has been found to be a potent weapon against rodents. Blast is the main fungus disease of paddy. The evolution of blast resistant strains like CO. 25 and CO. 26, has gone a long way to tackle the problem successfully. It is necessary to evolve short and medium duration strains resistant to blast and work is under way towards this end.

To maximise production in areas of precarious water supply as in Chingleput, North Arcot and Chittoor Districts it is necessary to evolve drought resistant strains of paddy. Several artificial crosses between cultivated rices and wild paddies have been effected with a view to evolving drought resistant strains and before long the evolution of drought resistant strains can be expected. Strains suitable for water logged areas and alkaline areas are now available. SR. 26-B has now become very popular for alkaline lands. In water logged areas PTB. 15 and 16 has been grown to great advantage.

The improved seed supplied to cultivators run out in the course of a few years and as maximum yields are bound up with purity of seed it is necessary to renew the supply once in three or four years. For the proper maintenance and distribution of improved strains the nucleus seed is to be maintained at the agricultural research stations. The multiplication of seed in primary and secondary seed farms and distribution are to be done for some time under departmental supervision.

Maximising Production and Development of Uganda - 1 Cotton Strain in Madras State *

By

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The introduction and functioning of the Certification Scheme presents a very favourable opportunity to maximise production and development of the improved Cambodia strain, Madras Uganda 1, in a pure state, on a large scale in a short period. The provisions of the Cambodia Co. 4 production and certification orders which are based on the conditions prescribed in notifications issued by Textile Commissioner, Bombay under the Cotton Control Order, require that the Uganda seeds sown by growers should be duly approved and supplied by the Department of Agriculture of the State, and the crop so raised alone is entitled to be certified by the scheme for purposes of exemption from price control. This proviso would naturally force the large number of Uganda growers in the concerned districts to approach the Department for supply of pure seeds during the coming season and consequently the demand for seeds would be heavy and the department should be in a position to maintain adequate stocks of pure seeds to meet the entire needs of the cultivators.

During 1951—'52 winter and 1952 summer seasons, the scheme registered for Certification, Co. 4 cotton crop raised both from Departmental seeds as well as from seeds of other sources, without any distinction being made and the crop was certified provided the minimum standard of 95% purity prescribed in the order was satisfied. A review of the purity of the crop raised from seeds of Departmental and non-departmental sources showed generally a higher level of purity in the former group. Nevertheless, the seeds procured could not possibly be of uniform purity in all cases, as they represented different lots obtained from different sources and places. The crop raised by the ryots from seeds of non seed farm origin supplied by the Department was in many cases far below the standard of purity prescribed for certification and the growers were unwilling to remove the off-types on the ground that the seed was supplied by the Agricultural Department and they were not responsible for the rogues, if any, were found in the crop. On the other hand the crop raised by many assiduous growers from their own stock of seeds or from seeds obtained from certain reliable private sources has been remarkably good with regard to purity.

What is therefore emphasized is that the Department should altogether give up the procurement and distribution of Uganda seeds of non-seed farm crops whose purity is invariably a doubtful factor. During 1952—'53 winter and summer seasons, it is estimated that an area of 67,000 acres would be sown to Uganda 1 crop both in the Southern and

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Northern zone together, for which about 17,000 bags of seeds would be required on the basis of a liberal seed rate of one bag for 4 acres. If the officers in charge of Uganda 1 seed muliplication and distribution schemes in the two zones can procure this quantity of pure seeds exclusively from seed farm crops and stock it for distribution to the cultivators in the next season, the problem of maximising the production and the development of the improved strain Madras Uganda 1, can be solved easily almost in one step. If however this target in the procurement of pure seeds is not attainable, the gap should be made up by arranging to procure seeds of crops raised by registered growers which have been inspected and examined in the field and assessed for purity and certified by the scheme. Further the kapas of such registered and certified crop would be ginned under the Departmental supervision only in specially licensed ginneries, where the produce will be examined again for quality and purity. Seeds of such desirable lots can be procured by the Department to augment its stocks to meet the entire demand from growers for supply of pure seeds giving up altogether procurement of seeds from non seed farms and from crops of unknown origin. Such a step would contribute towards maximising the production and development of Uganda 1 cotton in the Madras State in a pure state in a short period.

Methods to be adopted to Maximise the Production and Development of Improved Strains and Plant Material, in Relation to Horticulture *

By

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Fruits, vegetables, flowers and other horticultural crops have always had a perennial interest for man. Horticulture received considerable attention from the Hindu and Moghul Emperors who beautified their capitals and pleasure resorts with fruit and ornamental trees; some of the former, like the Jehangir and the Himayuddin varieties of mangoes are even now reputed for their luscious qualities. But then, horticulture had been a hobby of the well-to-do or the aristocracy and was not taken up as a serious avocation by the ordinary grower. There has therefore been a gradual and great decadence. However, the few gardens that have survived to the present day, still bear witness to the excellence reached by Ancient and Medieval India.

Lack of enterprise and tardiness in the adoption of improved methods have arrested to some extent the development of superior types. Some of the finest varieties which have originated by chance in nature, can only be perpetuated by artificial means, for, under free competition of natural selection they would disappear. As for systematic research and rapid building up of really comprehensive experimental plantations, we have yet a field of highly useful, most remunerative and intensely interesting work before us.

Present drawbacks: Some of the factors which have been responsible for lack of any tangible progress in this field are ennumerated by Naik (2) as follows: Neither among the producers nor among the consumers of our country, standardised fruit quality has counted for much. Quantity rather than quality, cheapness, rather than a standard of excellence, have been the ruling features of our fruit and vegetable markets. Even those who can afford and are willing to pay for good fruit are not always fortunate in securing what they desire. Under-production of good quality fruit is almost a common feature of all gardens or orchards. The private nursery trade and the indiscriminate purchase of plants may also be partly responsible for this state of affairs. The same spirit of indifference and ignorance explains the failure to take timely measures to control pests and diseases. Vegetable seed production being

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uncontrolled, the growers are largely at the mercy of irresponsible suppliers of seeds. While bad seed in agriculture results in the loss of a season's crop, a bad plant in fruit growing leads to recurring loss for many years.

Possibilities: It is indeed fortunate that Madras State possesses immense potentialities for development in this direction, on account of its diverse soil and climatic conditions. Horticultural crops of a wide range of types are found to thrive to an unexcelled degree and have proved to be the source of several essential and supplementary foods on the basis of quality, calorific content and nutritive value, and also have yielded highest returns per unit area.

Any plan of *development* of an improved strain has necessarily to follow one of *production.* Some of the methods through which such improved strains can be produced, are discussed below.

Introduction of varieties: The foremost plank of fruit development as stated by Rao (4) is introduction and testing of varieties. Most of the economic and industrial plants of Nilgiris are of a foreign origin. The apple, pear, plum, peach, strawberry, persimmon, mangosteen, litchi, durian, passion fruit, avocado etc. are some of the notable introductions in fruits. The Singapore jack introduced recently from Ceylon by the Director of Agriculture, Sri M. S. Sivaraman, has proved its worth by its precocious tendencies at the Kallar fruit station and has also been found to thrive successfully in four other districts of the State. Countless number of medicinal plants, plants yielding oil, essences, dyes, spices, beverages, condiments etc. which are all of great commercial value are found to thrive in our stations, and it is up to us to add to this wealth by constant introduction both from our rich native flora and from aboad. As Popeno (6) says, *Pomona* (meaning the Goddess of fruit) still shows herself as a savage beauty in the tropics, requiring the aid of culture for the full development of her attractions.

Selection: With most tree fruits, the earliest horticultural breeding consisted in sowing of seeds from specially grown trees, this being followed by multiplication of selected types by budding, grafting, layering and other such vegetative methods of propagation, for obtaining stable varieties. Later came the occasional selection through bud variation etc. By such means were obtained and preserved a number of cultivated forms from which most of our varieties have been selected.

Chance seedlings: By far the largest number of varieties grown at present have been obtained from seedling trees not grown with the purpose of producing new varieties. Singh (8) observes that selection of chance seedlings has given thousands of outstanding horticultural varieties of fruits, vegetables and flowers that 95% or more of the varieties produced in the world may be said to have been derived from some type of simple

selection. The *Chinnaswarnarekha* mango of the Circars, *Mundappa* of South Kanara and *Padiri* of Tamilnad are notable examples of such selection, the seed parents of which are believed to be alive even till today. A constant and vigorous search should therefore be made among our orchards, forests, home gardens etc., for spotting such outstanding types.

But sports, mutations, chimeras, polyploids etc.: Several new varieties and strains of fruit are known to have originated as budsports and many more ornamental plants have so originated. These sports or mutations are heritable variations in stem, leaf or fruit, resulting as a sudden change in the genitical constitution. Shamel (7) goes to the extent of saying that the differentiation of horticultural varieties in such a group as sweet orange or lemon has taken place mainly by somatic change or bud variation, without any frequent recombination of genes in sexual reproduction. Such changes have contributed significantly to the origin of new and improved plants. In the Washington Navel orange of U. S. A., 19 strains of considerable importance and five of minor economic sequence together with a large number of individual fruit and limb variations have been discovered. Improved plants of sweet pea, raspberry and other horticultural plants have similarly been obtained. It is beyond the scope of this paper to detail the several such discoveries in each kind of plant.

Instances of the undesirable results of such changes are also equally numerous and perhaps constitute a factor which deserves a more serious consideration. In fact, it is said that it was the discovery of perpetuation of worthless bud variations through unintentional propagation in commercial nursery practice that led to the study of bud variations. A study of a Washington Navel orange orchard is stated to have shown 352 very undesirable entire tree variations out of a total of 1,500 trees.

Polyploidy: Forms exhibiting polyploidy have also a similar importance. Many cultivated species of *Rubus* and common European plum are polyploids. Recently a giant form of pear, producing fruits of better quality and about twice the size and weight of the parent variety, has been reported from England. Citrus workers in California have spotted many tetraploid forms.

Artificial methods of inducing mutations, etc: The origin and evolution of all such plants is primarily due to accidental changes occurring in the cell during the course of reproduction. Modern research, however, has made it possible to induce such changes at will. The plants are subjected to any one of the following treatments (1) decapitation (2) extremes of temperature (3) X-ray (pollen or seeds can easily be given a sufficiently uniform X-ray on a rather large scale or flowers may be treated at the time of opening) and (4) use of radio-active substances etc.

Another such feature is the occurrence of Chimeras. Frost (1) recognised nearly eight such forms in citrus. While much cannot be said in favour of this phenomenon towards the improvement of varieties, the possiblity may be explored to protect a variety against certain diseases by providing an epidermis of a more resistant variety. Some of the variegated forms arising out of such chimeras are more or less suited for use as ornamentals.

Bud selection and tree selection: Experience has however shown that bud variations produce horticulturally inferior varieties more frequently than superior strains. 'Bud selection' as suggested by Frost (1) is more likely to maintain the standard type of a variety. Improvement and standardization by selection are recognised as highly important in Japan and the rapid growth of the *Satsuma* orange industry in the last 25 years is as stated by Tanaka, quoted by Shamel (7) largely the result of painstaking work on the part of nurserymen and growers along this line.

Bud selection may be used to isolate superior strains originating as bud variations to eliminate inferior strains through avoiding propagation of undesirable bud variations and to maintain the efficiency of valuable strains through systematic use of buds obtained from inherently stable and uniformly good fruiting trees.

The Fruit Growers Supply Company of Los Angeles, California organised a bud selection department in 1917, to supply growers and nurserymen with reliable citrus buds, obtained from carefully selected trees, of all the important citrus varieties in California. The number of buds of different varieties sold to growers and nurserymen was nearly six million. In addition to the buds supplied by the company, several growers developed their own sources of selected citrus buds. The trees selected are in the best available orchards, most of which have been planted to trees grown from "Supply Company" buds.

Hybridization: In recent times, the most important and perhaps one of the methods in wide practice is the production of improved strains through hybridization. Hybrids already produced in India and elsewhere indicate that fruits of especial excellence can be obtained by resorting to controlled crossing. Some of the noteworthy results in this field are:

(1) the production of over a dozen promising hybrid progenies of mango at the Fruit Research Station, Kodur, with the prospect of obtaining many more through nearly 100 progenies which have yet to fruit.

(2) Considerable number of varieties have been obtained by crossing the two species of Fragaria (Strawberry).

(3) With the apple, breeding of late blooming varieties was found possible. Promising results were obtained in breeding for a long keeping variety by crossing two varieties of apple.

(4) Nearly all varieties of grapes of American origin having very high quality have been the result of crosses between the American Species and varieties of *Vitis vinefera.*

(5) Citrus hybrids like tangelos, tangors, citranges, citrange-quats are only a few of the large number of hybrids produced by Swingle and his coworkers after considerable research.

(6) In fruit trees such as prunes, species hybridization has given rise to the common cultivated forms of *P. domestica.*

(7) The successful production of wilt resistant cabbage, tomatoes, watermelons and cowpea are other achievements in U. S. A.

(8) Success in ornamental gardening is phenomenal, notable among which are hybrids of *Antirrhinum, Dahlia, Delphenium* etc.

Exploitation of hybrid vigour is just beginning to receive attention. Among vegetables considerable amount of work on brinjals and tomatoes has been done in other countries, notable among which is that of Kakizaki, who evolved promising hybrids of brinjals.

Methods to maximize development of improved strains : The material presented in the foregoing pages indicate the several directions in which the *production* of improved strains can be maximized. Having successfully produced a desirable and improved strain the next problem calling for attention will be how best can these improved strains be developed ?

The following are some of the more important channels through which maximisation can be achieved.

Vegetative propagation: Propagation of selected strains through vegetative means of multiplication has been an ancient practice and continues to be the most effective method of perpetuating desirable strains. Several methods have been devised with fruits with varying results. Some are propagated easily while others are not or only with great difficulty. Horticultural literature is replete with instances of some propagational success in some part of the world, almost every day.

Scientific knowledge and skill in propagation: Scientific knowledge as Naik (2) observes, has not been utilised in this country to an appreciable extent, to secure a synthesis of the best in our native flora. This is especially true of horticultural propagation in which the few skilled workers are naturally confined to fruit growing localities. The Madras Department of Agriculture has now made a beginning to remedy this defect not only by organizing a post-graduate course in horticulture to train agricultural and science graduates in this specialised science, but also by training mazdoors at most of the Agricultural Research Stations in fruit propagation methods. The services of these trained personnel will be available for the fruit growers, for development of local promising types wherever they may exist. It is to be hoped that this step will help

detection of as many promising varieties as possible. This band of trained personnel while helping the growers in the above manner, could also be of service in guiding them to eliminate useless and unprofitable trees. Rao (4) in his survey of the fruit growing tracts in India reports about the success obtained in the Punjab where a number of useless ber orchards has been thus converted.

Progeny tests: The final test of stability and purity of a strain is the progeny test plot which determines the suitability of a strain for a particular region. Shamel (7) recommends that atleast four or preferably eight years of production by the progeny trees of the same strain should be used for study before conclusions regarding the nature of any progeny can be safely considered. From the progenies, which produce uniformly the fruit or foliage characters desired, further propagation of the most satisfactory trees can be made. The resulting trees may be considered as pedigree ones. Rao (4) cites the instance of a clonal progeny garden near Lyallpur where trees of different varieties have been raised from scion material collected of parents where fruits have won exhibition prizes. A similar progeny test with *Sathgudi* orange of known merit (also through exhibition prizes) is being carried out at the Fruit Research Station, Kodur, besides constant efforts for addition of such promising specimens to the nursery stock.

Establishment of regional stations: In order to carry out the above recommendations, it is very essential that regional horticultural research stations should be established. The National Planning Committee stressing this need have recommended the opening of a chain of horticultural research stations in each State where local problems with regard to the production and preservation of fruits, vegetables and flowers could be investigated in all their aspects.

A beginning has already been made in this direction by the establishment of five model orchard cum nurseries in the State. While the research stations serve as the workshops these model orchard cum nurseries are intended to be the show places where the results of research will be conveyed to the growers through practical demonstrations.

The National Planning Committee further suggested that a fruit section might be developed at the Indian Agricultural Research Institute, New Delhi, to serve as a clearing house for information on all aspects of fruit industry and to guide and coordinate research. The proposed section may also conduct an economic survery to prepare an accurate map of the country showing the relative merits and demerits of each tract for fruit and vegetable production. Till fruit research is undertaken on a more scientific basis in each region, the advisory work for extention of horticulture, will only be superficial based on uncertain foundations of foreign experience.

Vegetable Improvements: In the field of vegetable improvement, the quality of the seed material is of primary importance. The concluding plenary session of the Crop and Soils wing of the Board of Agriculture and Animal husbandry which met in April 1950, recommended enactment of legislation similar to the seed act in force in United Kingdom, U. S. A., Canada, etc. for assuring adequate and timely supply of pure seed of improved varieties. The importance of setting up regional seed testing laboratories was also emphasised. The role of Government vegetable seed stores in this regard has been largely recognised as beneficial. Rao (4) mentions details of schemes of vegetable seed production sponsored by the Indian Council of Agricultural Research at Kashmir and Quetta. The station at Quetta claims to be the largest seed producing centre in India for exotic vegetables. The organisation is said to consist of seven registered growers, who between them have nearly 300 acres under vegetable seed crops. None except the licenced growers, are allowed to raise vegetable crops for seed. The entire work of selection, seggregation of allied types and different varieties of the same type, cultivation, rogueing, harvests and seed collection is supervised by Government staff appointed for the purpose. The seed when collected is transferred to a central warehouse where the bags are sealed on arrival and labelled in the presence of the supervisory staff. No seed registering less than 70 per cent germination or which is more than two years old is distributed. This system is said to work satisfactorily as evidenced by large demand.

Propaganda: The results of research work have little value unless they are carried into practice on a large scale. The National Planning Committee suggested that propaganda should be intensified in the following directions.

(1) Holding short courses. (2) Holding regional fruit shows. (3) Arranging demonstrations and lectures with suitable illustrations at meetings and fairs. (4) Issuing circulars and leaflets of hoticultural interest. (5) Organising market intelligence bureau. (6) Establishment of a Provincial Horticultural Board on the lines of the Punjab Fruit Development Board or the U. P. Fruit Development Board or the Fruit and Vegetable Marketing Committee of Bombay.

Government policy: The success in actual extension depends to a great extent on the Government policy. The following concessions given by the Baroda Government is an instance of Government aid.

(1) Assignment of wastelands to prospective growers without assessment for 7—15 years, and full assessment thereafter. (2) Grant of bounty of Rs. 20/- per *bhiga* on all newly raised plantations, for 5 years. (3) Fruit nurseries to be developed and given away to fruit growers' associations. (4) Long term takkavi loans granted at special concessional rates for fruit growers.

The Ceded Districts Economic Development Board is of the opinion that the following steps would lead to extention of fruit industry in Madras.

(1) Grant of subsidies at Rs. 25/- per acre for few years to start with having a target of 20,000 acres under fruits. (2) Sinking 1000 wells by Government to irrigate about 5000 acres. (3) Grant of liberal loans to irrigate the balance of area, the first instalment of repayment commencing when trees begin to yield. (4) Establishment of fruit nurseries in each district and control of private nurseries. (5) Technical advice. (6) Periodic surveys once in five years to assess the progress made and guide the orchardists on correct lines (A survey was undertaken in 1948 of most orchards in the State which have been planted to fruit varieties supplied by Government nurseries. A further survey is also being conducted on similar lines). (7) A soil map of the State showing the underground water table and a knowledge of success and failure of fruit plantations in different parts of the State.

Reporting on the facilities afforded by the Punjab Government Rao (4) says that the concessions in the shape of extra supply of canal water has stimulated all round interest in fruit culture and the owners are alive to the possibilities of improvement of the existing orchards and further extension.

Co-operative Societies; Multipurpose co-operative societies can be organised to secure the required finance and arrange for the purchase of required implements and manures, and dispersal of produce. Fruit marketing societies, as those existing at Kodur and Palacole in West Godavari may also be formed in all the fruit growing centres. Formation of fruit grower's associations is necessary to discuss and disseminate results of research.

Other facilities: Other requisites of no mean significance are good roads, transport facilities, availability of sufficient manure, skilled labour etc., all of which have contributed to phenominal success in horticultural development in countries like France, England, U. S. A. and China of late.

Improvement of preservation and investigations on the manufacture of byproduct industries like papain, chickle, banana fibre etc. deserve careful attention to avoid wastage of raw material due to gluts in the market.

Trade facilities: In order to encourage external trade of horticultural produce import duties on foreign goods may be raised and brought to a level with duties charged by foreign countries. Transport charges may be lowered. If cold storage facilities are provided at the ports and on steam ships our country can build up a huge trade in mango alone, since this is the monopoloy of tropical countries.

Though not strictly relevent to the question of production, these are factors which the fruit grower is bound to take into consideration when embarking on a long range venture like horticulture.

Summary:

1. The present drawbacks in Indian horticulture with the possibilities for remedying them have been ennumerated.

2. The following methods have been suggested for maximization of the production of improved strains and plant material.

(a) Introduction of varieties and study in relation to wild relatives.

(b) Selection.

(c) Location of chance seedlings, mutations, bud variations, chimeras, plants exhibiting polyploidy and methods to induce these changes by artificial means.

(d) Breeding to evolve economic and superior strains and exploitation of hybird vigour.

3. For the development of improved strains, the following methods are suggested.

(a) Vegetative propagation.

(b) Conduct of progeny tests.

(c) Establishment of regional research stations and a central horticultural section.

(d) Vegetable seed distribution through Government vegetable depots and through licenced seedsmen.

4. The need for an efficient system of propaganda to transmit the results of research has been emphasised,

5. The necessity and importance of the part that Government could play in implementing the above suggestions by way of providing amenities such as assignment of land and under favourable terms, grant of loans, establishment of co-operative societies, provision of roads, improvement of transport and trade facilities, improvement of fruit product and byproduct industries etc. have been indicated.

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Crop and Trade Report

Cotton Raw in the Madras State: The receipts of loose cotton at presses and spinning mills in the Madras State from 1st February 1953 to 20—3—1953 amounted to 27,121 bales of 392 lb. The receipts in the corresponding Period of the previous year were 15,773 bales. 58,578 bales mainly of pressed cotton were received at spinning mills and 25 bales were exported by sea while 130 bales were imported by sea the progressive totals being 1,004 bales exported and 14,980 bales imported from 1—2—1953 to 20—3—1953.

Research Note

Contributions of the so called inert fractions of the soil towards the release of the nutrients

By

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The earlier concepts on the activity of soil were for the most part based upon analyses of (or experiments with) the whole soil. It has long been considered that besides organic matter, the only other important fraction which assists crop growth is the clay which takes part in the exchange capacity and the fertility of the soil. The coarser silt and sand fractions were considered until recently as almost inert.

Hendrick and Ogg (1915) were perhaps the first to analyse the different soil fractions for determining the composition of the soil. Hendrick and Newland (1923) emphasized that it is only when the silt and fine sand are examined that the real significance of the activity of the soil is brought out. Hosking (1948) came to the conclusion that silt and sand fractions are not so inert as have been considered so far. In their previous publications Pathak, Mukerji and Shrikhande (1949—'52) have tried to assess the contributions of the different fractions of the soil towards their cation-exchange capacity (1949), potash-fixing capacity (1950), phosphate-fixing capacity (1950), nitrogen-fixing capacity (1951) and nitrifying capacity (1952). In the present paper attempts are being made to assess the contributions of the different fractions of the soil towards the release of the nutrients. The following are the results of analyses of different fractions of the soil.

TABLE 1.

Fusion analysis of sand fraction, expressed on 100 gms. sand.

	Manured.			Unmanured.		
Percentage	0—6″	6″—1′	1′—2′	0—6″	6″—1′	1′—2′
Air dry moisture	0·18	0·26	0·27	0·21	0·21	0.21
Loss on ignition	0·58	0·34	0·41	0·50	0·41	0·36
Insoluble SiO_2	84·43	84·24	84·11	84·29	84·40	84·09
Fe_2O_3	2·00	1·80	1·80	1.80	1·80	1·60
Al_2O_3	7·31	7·25	7·00	7·28	7·15	7·14
R_2O_3	9·31	9·05	8·80	9·08	8·95	8·74
K_2O	2·70	2·32	1·97	2·59	2·29	1·88
M_gO	0·66	0·71	0·71	0·67	0·75	0·73

TABLE 2.

Fusion analysis of silt fraction, expressed on 100 gm silt.

	Manured.			Unmanured.		
Percentage	0—6″	6″—1′	1′—2′	0—6″	6″—1′	1′—2′
Air dry moisture	0·26	0·48	0·62	0·72	0·63	0·48
Loss on ignition	2·32	2·46	2·76	3·02	2·65	2·54
Insoluble SiO_2	66·44	66·20	66·42	66·10	66·37	66·22
Fe_2O_3	3·40	3·40	3·00	3·60	3·80	3·60
Al_2O_3	19·53	18·83	19·23	18·88	17·90	18·38
R_2O_3	22·93	22·23	22·23	22·48	21·70	21·98
K_2O	6·33	6·53	6·48	6·64	6·69	6·78
MgO	1·06	1·36	1·56	1·56	1·76	1·92

TABLE 3.

Fusion analysis of clay fraction, expressed on 100 gm clay.

	Manured.			Unmanured.		
Percentage	0—6″	6″—1′	1′—2′	0—6″	6″—1′	1′—2′
Air dry moisture	5·58	6·02	8·34	7·50	7·62	10·30
Loss on ignition	7·58	7·50	7·68	8·90	8·24	6·56
Insoluble SiO_2	40·07	43·10	41·91	41·50	41·88	40·42
Fe_2O_3	7·60	7·20	6·40	6·20	7·20	6·00
Al_2O_3	26·40	25·30	25·30	24·10	25·50	29·90
R_2O_3	34·00	32·50	31·70	30·30	32·70	35·90
K_2O	4·35	4·15	4·05	4·12	4·09	3·92
MgO	1·71	1·80	1·91	3·12	2·04	1·94

When the results of sand, silt and clay are compared, it will be seen that air dry moisture and loss on ignition increased with the fineness of the particles. The presentage of Fe_2O_3 and MgO increased and the percentage of SiO_2 decreased with the increase of the size of particles. This applied for both the manured and unmanured plots. But the distribution of K_2O was irregular. It was maximum of over 6% in silt, 4% in clay and about 2% in sand, Hendrick and Ogg (1915) also observed a similar phenominon. The R_2O_3 content of clay at different depths is greater than that of silt and sand at corresponding depths. Since Al_2O_3 is more than Fe_2O_3 in the clay fraction, it may be concluded that the soil in question is "illite" or "mica". This nature of the soil is further indicated by its K_2O content which is 4% in clay.

From the mechanical analysis of the soil Pathak, Mukerji and Shrikhande (1949) inferred that the soil under investigation is a silt loam. The analysis of silt and fine sand fractions which are on an average 20 — 60% of the soil respectively, clearly suggests that silt and fine sand fractions can now no longer be ignored in assessing the total activity of soils.

A glance at above tables indicates that there is no remarkable variation in the nutrient contents of both the plots. This suggests that the soils of the two plots have a common origin.

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Agricultural College and Research Institute Library, Coimbatore

LIST OF ADDITIONS DURING THE MONTH OF MARCH 1953

1.	CHERIAN JACOB (C. K.	Madras Bananas – a monograph, Ist Edition, 1952, Superintendent, Government Press. Madras.
2.	INDIA BIOLOGICAL CHEMISTS (Society of)	Annual review of Biochemical and allied Research in India. Vol. XXII 1951, Society of Biological Chemists – India.
3.	INDIA MILITARY SURVEY (Director of)	Gazetter of India and Pakistan, Ist Editions, 1950. Director of Military Survey India.
4.	INDIA SCIENTIFIC & INDUSTRIAL RESEARCH (Council of)	Wealth of India – Vol. III D-E. 1952. Council of scientific and industrial Research India.
5.	INDIAN SOCIETY OF AGRICULTURAL ECONOMICS	Problems of farm costs in Indian Agriculture, Ist Edition, 1953 – Indian Society of Agricultural Economics.
6.	IOWA STATE HORTICULTURAL SOCIETY	Transactions Vol. LXXXVI. 1951, Iowa State Horticultural Society.
7.	REMPTHORNE (oscar)	Design and analysis of experiments. Ist Edition 1952. John Wily & Sons.
8.	SAUGUR UNIVERSITY	Calender for 1950—'53 University of Saugar.
9.	WELLHAUSENCE (J)	Races of Maize in Mexico, Ist Edition, 1952. Bussey Institute of Harverd University.

Gleanings

Theory of Earth's inner core: For some years it has been known that the earth contains a central core with a radius of 2,200 miles. This central core is physically distinct from the outer mantle, which extends up the further 1,800 miles to the earth's surface. Several distinct lines of evidence have pointed to the bulk of this central core being in a fluid state. Over the years from 1935 to 1939, it was concluded that the central core contained an inner core with a radius of about 800 miles. Professor Bullen, Professor of Mathematics at Sydney University, Australia, has recently adduced some evidence to the effect that while the outer part of the central core is fluid, the inner core is solid, with a density of about 18 times that of water. There is some division of opinion on the question of the composition of the outer part of the central core, but his work favours the view that the central core consists of a high density liquid from of silicate rock with a density about 11 times that of water, and that inner core is chemically distinct and consists of iron, nickel and probably some denser metals.

Scientific Spirit of Ancient India: The development of a rational attitude of mind and a spirit of inquiry into the mysteries of the universe, which form the basis of all scientific study, is rightly claimed to be one of the greatest legacies of Greece to humanity. As in Greece, so in India, speculative philosophy was followed by a true scientific inquiry based on close observation of facts and phenomena. The method of science, which has been described fully in Indian literature, involves, among others, perception, observation, experiment, inference and hypothesis. By application of this method great advances were made in astronomy and medical science including anatomy and surgery. These led to the growth of other sciences snch as mathematics and chemistry. The actual achievements of the Hindus in these branches of science were very great and compare favourably with those of any other ancient people.

Even in other branches such as botany, zoology, mineralogy, mettallurgy and physics, where actual attainments were not as great, we find the scientific process at work, viz., observation and classification of phenomena, experiment and inference. As regards botany, reference may be made in particular to the classification of plants, treatment of seeds for successful germination, study of diseases of trees and the method of improving flowers and plants even to the extent of changing their essential properties. More striking is the detection in plants of the phenomena of life and death, sleep and waking consciousness, of pleasure and pain, sensitiveness to heat and cold, and movements towards what is favourable and away from what is unfavourable. In zoology we find various classifications of animals on the basis of their *vija* (ovum or seed) the number of senses possessed by them and according to their habitat, mode of life and dietary value. In mineralogy and metallurgey we have reference to the working of underground mines, manufacture of various metals and a scientific process of treating metals. The iron pillar of Delhi is a living testimony to the forging of iron on a scale unknown to recent times and the process, now forgotten, of evolving a type of iron which does not rust in 1,500 years. The true nature of gems and their classifications show some knowledge of geology.

The study of ancient Indian science is yet in its infancy, and if India suffers in this respect in comparison with Greece and other countries, it is perhaps due more to our ignorance than to her actual backwardness, either in scientific spirit or in actual achievements in various branches or science.

(Current Science Vol. 21, No. 12, December 1952).

Weather Review — For the month of March 1953

RAINFALL DATA

Division	Station	Total rainfall for the month in inches.	Departure fromnormal in inches	Total since 1st January in inches	Division	Station	Total rainfall for the month in inches.	Departure fromnormal in inches	Total since 1st January in inches
Orissa & Circars	Gopalpur	0·0	—0·6	2·3	Central Contd.	Vellore	0·0	— 0·3	0·1
	Calinga-patnam	0·0	—0·4	1·1		Gudiyatham*	0·0	— 0·4	0·0
	Visakha-patnam	0·0	—0·5	2·1		Salem	0·0	— 0·5	Tr.
	Arakuvalley*	0·0	—0·9@	0·1		Coimbatore (A. M. O.)*	Tr.	— 0·3	0·1
	Anakapalle*	0·0	—0·3	0·3		Coimbatore	0 0	— 0·5	0·2
	Samalkot*	Tr.	—0·3	0·3		Tiruchirap-palli	0·0	— 0·4	0·7
	Kakinada	0·0	—0·5	0·1					
	Maruteru*	0·0	—0·5	Tr.	South	Naga-pattinam	0·1	— 0·7	3·7
	Masuli-patnam	0·0	—0·4	Tr.		Aduturai*	0·0	— 0·5	1·7
	Guntur*	0·0	—0·2	0·0		Pattukottai*	0·0	— 1·4	4·5
	Agrl. College, Bapatla*	0·0	—0·9	0·0		Mathurai	0·1	— 0·6	0·9
						Pamban	0·0	— 0·7	1·7
	Agrl. College, Farm, Bapatla*	0·0	X	0·0		Koilpatti*	0·5	— 0·9	0·8
						Palayam-cottai	0·5	— 0·5	2·8
	Renta-chintala	0·0	—0·1	0·1		Amba-samudram*	1·7	— 0·7	5·3
Ceded Districts	Kurnool	0·0	—0·2	0·0	West Coast	Trivandrum	0·2	— 1·3	2·9
	Nandyal*	0·0	—0·5	0·0		Fort Cochin	3·2	+ 1·2	3·6
	Hagari*	0·0	—0·2	0·0		Kozhikode	0·2	— 0·2	1·0
	Siruguppa*	0·0	—0·1	0·0		Pattambi*	1·4	+ 0·6	1·7
	Bellary	0·0	—0·2	0·0		Taliparamba*	0·0	— 0·5	Tr.
	Cuddapah	0·0	—0·2	0·0		Wynaad*	0·2	— 1·2	2·2
	Kodur*	0·0	—0·5	0·1		Nileshwar*	0·0	— 0·1	0·1
	Anantapur	0·0	—0·2	0·0		Pillicode*	0·0	— 0·4	Tr.
						Mangalore	0·2	— 0·3	0·2
Carnatic	Nellore	0·0	—0·2	0·1		Kankanady*	0·0	— 0·6	Tr.
	Buchireddi-palem*	0·0	—0·3	0·1	Mysore & Coorg	Chitaldrug	0·0	— 0·2	0·0
	Madras (Meenam-bakkam)	0·0	—0·3	1·4		Bangalore	0·0	— 0·4	0·2
						Mysore	0·0	— 0·5	0·1
						Mercara	0·3	— 0·5	0·3
	Tirur-kuppam*	0·0	—1·0	0·3	Hills	Kodaikanal	1·2	— 0·6	4·4
	Palur*	0·0	—0·6	0·8		Coonoor*	6·0	+ 3·5	16·4
	Tindivanam*	0·0	—0·6	0·5		Ootacamund*	0·6	— 0·8	1·5
	Cuddalore	0·0	—0·7	1·4		Nanjanad*	Tr.	— 1·1	1·2
Central	Arogyavaram (Chittoor dt.)	0·0	—0.5	0·1					

Note :—

1. * Meteorological Stations of the Madras Agricultural Department.
2. @ Average of eight years data for Arakuvalley is given as normal.
3. Average of ten years' data is taken as normal.
4. X The Farm was started only in 1951.
5. Tr. Rainfall 1 to 4 cents.

Weather Review for the month of March, 1953

A low pressure wave was moving westwards through the Comorin area on the first day of the month and passed away across the extreme South-east Arabian Sea on the following day. A shallow low passed over Madhya Pradesh and the adjoining areas due to a Western disturbance on 3—3—1953 and became unimportant on the very next day over Chota-Nagpur. A shallow cyclonic circulation lay over the extreme South of the Peninsula upto 3,000 feet above sea level on 6—3—1953 and moved away Westwards. A weak low lay over east Vindhya-Pradesh and the neighbourhood on 10—3—1953. A shalow low appeared over North Bihar and the neighbourhood on 13—3—1953 and moved away across North East Assam on the next day itself. Another low formed over Chota Nagpur and the adjoining area on 16—3—1953 and become less marked on the following day. There was a weak inflow of moist Bay air into the North-East India on 19—3—1953 and a trough extended from East Uttar Pradesh to the Gangetic West Bengal. Dry continental air prevailed over the country on 20—3—1953, except over Assam, West Bengal and the extreme South of the Peninsula. A cyclonic circulation existed over Travancore-Cochin and the adjoining South-East Arabian Sea on 21—3—1953, causing fairly widespread rains in Travancore-Cochin and showers at a few places in South Tamil Nad. A shallow low appeared over North Bihar and the adjoining parts on 24—3—1953, and weakened on the very next day. A weak surface low existed over Chota Nagpur and the neighbourhood on 27—3—1953 and an extended surface trough lay over Coastal Andhradesa and Tamil Nad on 29—3—1953. Dry continental air prevailed over the whole country except North-East India and the South Peninsula on the last two days of the month.

A series of five Western disturbances, with their associated secondaries passed over North West India during the month.

Day temperatures were generally above normal over the Madras Region during the month. They were especially 10–12°F above normal over the Southern Districts of Coastal Andhradesa and Coastal Tamil-Nad on 29—3—1953. Rentachintala recorded the highest maximum temperature of 112°F on 28—3—1953, followed by Gannavaram, Ongole and Nellore, which recorded 110°F on 29—3—1953.

The noteworthy rainfalls and the Zonal rainfall for the month have been furnished hereunder:—

Noteworthy rainfalls for the month.

S. No.	Date	Name of place.	Rainfall for past 24 hours.
1.	6—3—53	Coonoor	5·20″
2.	12—3—53	Cochin	1·90″
3.	28—3—53	Pattambi	1·35″
4.	,,	Allepey	1·10″

Zonal Rainfall.

S. No.	Name of zone.	Average for the month	Departure from normal	Remarks.
1.	Orissa and Circars	0·00″	—0·43″	Below normal
2.	Ceded Districts	0·00″	—0·23″	,,
3.	Carnatic	0·00″	—0·45″	,,
4.	Central Districts	0·00″	—0·41″	,,
5.	South	0·36″	—0·75″	,,
6.	West Coast	0·54″	—0·28″	,,
7.	Mysore and Coorg	0·08″	—0·40″	,,
8.	Hills	1·95″	+0·25″	Just above normal.

Agricultural Meteorology Section,
Lawley Road P. O., Coimbatore,
Dated: 11th April, 1953.

M. B. V. N., C. B. M. & M. V. J.

Departmental Notifications

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,, Krishnaswamy, P.	Asst. Millet Specialist, Coimbatore	Asst. Millet Specialist, Nandyal
Dr. Mariakulandai, A.	Asst. in Chemistry, Coimbatore	Asst. Agrl. Chemist on Probation, Coimbatore
Sri Prabhakara Sastry, C.	D. A. O., under Training	Central Farm, Coimbatore
,, Srinivasa Rao, B.	D, A. O., under Training	Central Farm, Coimbatore
,, Somayajulu, P.	Seed Dev. Asst., Srikakulam	D. A. O., Nellore
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,, Govada Tenali		Addl. Demonstrator, Kurnool
,, Habibullah, K. S.	A. D., Parvathipur	Seed Dev. Asst. (Paddy) Srikakulam
,, Jayaseelan, D. S.	Trainee in Engineering	A. D., Tirupathur
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,, Kannan, S.	A. D., Pattukottai	A. A. D., Rasipuram
,, Lakshmipathi Rao, V.	Storage Asst., Guntur	Marketing Asst., Kakinada
,, Mahal, V. N.		Addl. Demonstrator, Kurnool
,, Muddanna Shetty, S.	A. D., Karkal	Fruit Asst., Taliparamba
,, Mallikarjuna Rao, Y.	A. A. D., Attur	A. D., Parvathipuram
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,, Nalla Gownder, S. C.	Trainee in Engineering	Spl. A. D., Sugarcane Villupuram
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,, Narayana Rao, K.	A. A., Cuddapah	Journal Asst., Kannada D. A's Office, Madras
,, Narayanankutty, K. G.	Fruit Asst., Taliparamba	A. A, D., Shoranur
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,, Narasimhamurthy, D.	Horticultural Asst., Anakapalle	Fruit Asst. Kodur

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,, Satyanarayana Raju, G.	A. D., Vijayanagaram	A. D., Visakapatnam
,, Subramaniam, B.	A. D., Kallakurichi	Soil Conservation Asst., Vayalpad
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,, Vedachalam, C. D.	Trainee in Engineering	Soil Conservation Asst., Dharapuram
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,, Vijayam, P. K.	Paddy Asst., Taliparamba	Paddy Asst., Pattambi
,, Venkateswaran, A. N.	Asst. in Oil Seeds, Nileshwar	Coconut Nursery Asst.. Coimbatore
,, Venkataramana Reddy, G.	Spl. A. D., Sugarcane, Madanapalle	A. D., Rajampet
,, Venkateswara Rao, M.	A. A. D., Panamarathu-patty	A. D., Vijayanagaram